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ASIAN ELEPHANT TO URBAN DWELLERS  
EXCEED THEIR COST TO THE  
FARMERS? A SRI LANKAN STUDY**

**R. Bandara & C. Tisdell**

School of Economics  
University of Queensland  
Queensland 4072 Australia

e-mail: [c.tisdell@economics.uq.edu.au](mailto:c.tisdell@economics.uq.edu.au).

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# Does the Economic Value of the Asian Elephant to Urban Dwellers Exceed their Cost to the Farmers? A Sri Lankan Study

Ranjith Bandara and Clem Tisdell\*

*School of Economics, The University of Queensland, QLD 4072, Australia.*

## Abstract

*Urban dwellers and farmers in the areas affected by human-elephant conflict in Sri Lanka are often in discord about the conservation of wild elephant in Sri Lanka. The urban dwellers regard this species as a valued resource but farmers in these areas consider it as an agricultural pest that interferes with their farming practices. This dual character of the elephant as both an agricultural pest and a economic asset reflects a difficulty in classifying it as a pest or as a resource. However, it seems that compensating farmers for the damages caused by elephants is essential, if this endangered species is to survive in the long run. This paper uses the results from contingent valuation survey of a sample of urban residence in Colombo in order to examines whether the urban dwellers willingness to pay for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants and to raise farmers' tolerance of the present elephants on their farming fields. We find that the annual return for the total extrapolated WTP of urban residents (Rs. 2012.43 million) in Sri Lanka is nearly twice the extent of crop and property damage caused to farmers by elephants (Rs. (Rs.1121.42 million) per annum. This indicates that the policy of compensating farmers by urban dwellers for elephant damage so the farmers will tolerate elephants on their farming fields might be viable. Furthermore, this also suggests that there is a strong economic case for the conservation of the wild elephant population in Sri Lanka, at least at their current population level.*

**KEYWORDS:** Asian elephant, *Elephas maximus*, Elephant conservation, Willingness to pay, Contingent valuation, Sri Lanka.

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\* Corresponding author, Professor Clem Tisdell, Tel: + 61 7 3365 6570; Fax: + 61 7 3365 7299; E-mail: [c.tisdell@economics.uq.edu.au](mailto:c.tisdell@economics.uq.edu.au). Ranjith Bandara is a Senior Lecturer in Economics on leave from the Department of Economics, University of Colombo, Sri Lanka: E-mail: [s200516@student.uq.edu.au](mailto:s200516@student.uq.edu.au).

## 1. INTRODUCTION

The Asian elephant (*Elephas maximus*) is one of the world's most seriously endangered species of large mammals IUCN (1996). In many respects, the survival of this species is more precarious than that of the African elephant (Bandara and Tisdell, 2002a). At present, it occurs in only thirteen countries in Asia, including Sri Lanka (Kemf and Santiapillai, 2000) and its population has fallen significantly. The Sri Lankan elephant population, for example, underwent a marked reduction starting from the mid-nineteenth century (Santiapillai, and Jackson 1990, De Silva, 1998). Fragmentation and loss of natural habitat are the major factors contributing to this decline and these help generate human-elephant conflict (HEC) (Desai, 1998). At present, more than 80% of the existing elephant habitat in Sri Lanka has some form of human disturbance (Karyawasam *et al.* 2002) and this situation has forced the affected wild elephant to intrude into human use areas where crops act as a dietary substitute. Weerakoon (1999) points out that the worsening of the outcome of the HEC in Sri Lanka is largely results from the *ad hoc* development projects carried out during the last fifty years, and is exacerbated by the lack of co-ordination between different government departments and wildlife authorities (Kotagama, 1997). Moreover, poor integration of economic aspects and lack of attention to public preferences for elephant conservation compounds the problem.

Several techniques are available for measuring the economic value that members of the general public place on the conservation of wildlife and other natural resources. These include the hedonic pricing approach (HPA), the travel cost method (TCM), and the contingent valuation method (CVM) (Carson *et al.* 1996). However, the HPA and TCM have been criticised by a number of authors for failing to measure the non-use or intangible values of wildlife adequately (see Stevens *et al.* 1995; Oglethorpe and Miliadou, 2000). The CVM is free from this particular criticism. It is able to elicit types of benefits that these other methods cannot elicit (Kotchen, 2000). CVM uses survey questions to elicit people's stated preferences for

public goods such as conservation of elephants (Ready *et al.* 1996; Loomis and Ekstrand, 1998; White *et al.* 2001). However, CVM also has limitations. It can for example, involve errors in estimation of economic value due to strategic, design, part-whole and hypothetical biases (Bateman and Turner, 1993).

Nevertheless, CVM is a widely applied monetary evaluation method (see Carson *et al.*, 2001; Söderholm, 2001). For example, it has been widely applied to the valuation of environmental and natural resource-related goods such as the preservation of wildlife species and outdoor recreational amenities (see Seip and Strand, 1992; Diamond and Hausman, 1994; Jakobsson and Dragun, 1996; Loomis and White, 1996; Wills and Powe, 1998; Witzer and Urfei, 2001, Bandara and Tisdell, 2002b). In CVM, the non-use economic values of a given environmental amenity are generally measured based on the willingness to pay for an improved situation, or using the willingness to accept compensation for a damaged or diminished situation. An appealing aspect of the contingent valuation method is that it allows us to estimate total economic value (Pate and Loomis, 1997). It is widely used. Carson *et al.* (1994) provide a bibliography of 1,600 CVM studies and related publications.

In economics, the importance of total economic valuation of wildlife and other natural resources is increasingly recognized. Estimates of total economic value combine willingness of stakeholders to pay for their direct interactive use of wildlife for harvesting, tourism or other purposes plus economic values generated by other than direct interactive use such as from the knowledge that a species continues to exist (existence value) or that it will be available to future generations (bequest value). Such willingness to pay can be influenced by feelings of moral obligation towards a species (cf. Tisdell, 1997; Etzioni, 1988). CVM is designed to capture all values that influence willingness to pay to conserve (or eradicate) a species. Therefore, it is a considerable advance on those economic techniques that merely measure

economic value generated by direct use of a species. As a rule, these only given partial indications of economic value. Nevertheless, economic methods, such as CVM, represent only one philosophical approach to value. One should be clear that despite its wide perspective, CVM does not constitute a complete or exclusive approach to valuation (Tisdell, 1997; cf. Lehman, 1993). Yet, provided this is kept in mind, methods, such as CVM, designed to determine total economic valuation can significantly enhance our appreciation of social choices involving conservation of wildlife. The purpose of this article is to show how analysis using CVM can provide new perspectives on the desirability of conserving Asian elephants in Sri Lanka.

Our study involved first a CVM survey of a sample of urban residents in Colombo, the capital of Sri Lanka, in order to determine their WTP for the conservation of the Asian elephant. This was then used to estimate the willingness of Sri Lankan urban dwellers, as a whole, to pay for conservation of the Asian elephant. A dichotomous choice form of contingent valuation is applied to quantify the conservation value of the wild elephant. An analysis is undertaken to investigate the underlying factors that determine the willingness of urban respondents to pay for the conservation of the elephant. Furthermore, in this analysis we consider whether urban residents' WTP for the conservation of elephants is sufficient to compensate farmers for the damage caused by elephants and to raise farmers' tolerance of the present elephants on their farming fields. The survey procedures are outlined first. This is followed by analysis of the results. The economic losses associated with crop and property damages caused by elephants are then compared with the estimated urban WTP benefits in order to determine whether the urban residents' potential contribution for conservation of elephants would be sufficient to compensate farmers for the crop and property damage caused by elephants and consequently raise farmers' tolerance of the presence of elephants

## **2. CONTINGENT VALUATION MARKET TO ASSESS THE CONSERVATION VALUE OF THE ELEPHANTS IN SRI LANKA**

Interviews with urban respondents involved four different steps. In the first step, the respondents were presented with updated information about the present status of the elephant population in Sri Lanka, and the policy and institutional issues that need to be addressed to conserve elephants in the country. Respondents were then told why it is important to adopt new approaches to ensure the survival of the elephant in Sri Lanka in the long-term. They were informed that existing protected areas are inadequate in size to ensure the long-term survival of wild elephants if elephants are confined to these areas. Furthermore, there is little or no prospect of a significant increase in the size of these areas. Thus, the survival of elephants seems to depend on their use of both protected areas and non-protected areas. Socially acceptable strategies for an appropriate level of co-existence between farmers and elephants are needed. Such co-existence hinges on greater compensation for farmers to tolerate elephants to a greater extent than currently.

In the second step, the survey respondents were presented with an alternative policy designed to address these issues. They were asked to assume that an autonomous body, reputed for its efficient and honest work, would introduce a sound conservation programme so that the current downward trend in elephant population could be halted while addressing other elephant related issues. The respondents were informed that this organisation would initially implement the following measures for the conservation of the elephant: a) Provision of extra protection around existing national parks and protected areas, b) translocation of excess and troublesome elephants, c) domestication of the elephants for local and foreign zoos, tourist establishments, temples, study centers, or for use as work animals, and d) establishment of animal orphanages and recreation centers to promote eco-tourism. Respondents were also informed that this policy

alternative was developed based on the assumption of that the conservation of elephants can be achieved through integrated policies involving both public and private landholders in the elephant's range and other interest groups, such as city-dwellers.

In the third step, the respondents were informed about the need to finance the proposed programme and the required support of the general public to establish a 'trust fund' to support the proposed conservation programme. Moreover, they were also told of possible benefits that they would be able to obtain after the successful implementation of this programme. The benefits presented to the respondents were: a) greater possibilities to view more elephants in a single herd in the wild, b) greater opportunities to see elephants in the wild during a short number of visits to a given national park, c) opportunities to domesticate more elephants for the purpose of religious festivals and the local tourism industry, and d) increase in agricultural crop production due to the mitigation of HEC in the main agricultural regions in the dry zone of the country.

Finally in the fourth step, the respondents were presented with the contingent market valuation question: *"For the next five years, would you be willing to pay Rs X from the monthly income of your household, that is Rs X per year, starting from January 1<sup>st</sup> 2002, towards the establishment of the proposed trust fund to implement the above mentioned programs to conserve the elephants in the country"*. The dichotomous choice format with a set of optional follow-up questions was used as a WTP elicitation technique (see FAO, 2000). These follow-up questions were always conditional on the respondent's response to the bid value offered in the previous question i.e. if the response to the initial question was 'no', the amount offered would be lowered for the next follow-up questions. If the respondent's response was 'no', this process was continued by reducing the bid value offered on each occasion, until the lowest bid value in the bid list was reached. Whittington (1998) discusses the significance of this method

in the context of developing countries. Moreover, more recently, Memon and Matsuoka (2002) empirically tested the validity of the contingent valuation method in general, in the developing country context, from a case study of rural Pakistan.

A non-obligatory, specific voluntary contribution mechanism (VCM) was used to determine the survey respondents' likely contributions to the proposed scheme. A number of recent contingent studies, for example, Champ *et al.* (1997), Chilton and Hutchinson (1999) have used this mechanism to motivate respondents to tell the truth. FAO (2000) concludes that the use of conventional bid vehicles such as variations in income tax, entry charges, property tax and changes in utility bills, reduce the willingness of respondents' motivation to tell the truth in these countries. Bohara *et al.* (1998) indicate that the VCM often creates a believable scenario while reducing the hypothetical nature of contingent valuation procedures. However, the VCM and its derived values are not without criticisms. For example, Berrens *et al.* (2002) argue that their application in absence of a coercive provision rule could create both free-riding and warm-glow giving situations. Johannesson *et al.* (1998) indicate that the VCM may create incentives to overstate hypothetical donations if respondents do not believe payment will be required. Nevertheless, more recently, Whittington, (2002) argued that respondents in developing countries could be motivated more towards truth telling through the VCM than the conventional bid vehicles.

### **3. SAMPLES, DATA COLLECTION PROCEDURE AND METHOD OF ANALYSIS**

The surveyed population was purposefully chosen from urban residents in Colombo. The population density, level of urbanisation, living standards and life style of residents were taken into account for the selection of a sample of urban residents. A sample of 300 residents was chosen from three main housing schemes in Colombo, *Jayanthipura*, *Jayawadanagam*, and



*Anderson Flats*. The Urban Development Authority of Sri Lanka (2001) classifies these schemes as upper middle class, middle class and lower middle class housing schemes respectively. This classification is based on the value of the property and other urban facilities in the area where these housing schemes are located i.e. public schooling, shopping centers and recreational sites. A hundred residents from each of these housing schemes were chosen as the sample. A stratified sampling procedure was adopted in selecting this sample. The socio-economic characteristics of the sample are summarized in Table 1.

**Table 1:** A summary of socio-economic characteristics of the sample

Variable	Mean	Standard deviation
Household size	3.130	1.141
Gender (male=1)	1.390	0.49
Age (in years)	44.021	10.860
Years of schooling	12.540	3.120
Personal income (in Rupees)	12986.67	8692.046
Number of income earners	2.581	1.700
Total monthly family income (in Rupees)	25166.671	18889.015

An interview schedule (IS) was used to gather the information used in the analyses presented in this paper. This consists of five different sections. The first section of the IS contained the personal profile of the respondent. The second contained questions to assess the attitudes of the respondents on 'development' and 'environment'. Section three presented respondents with information about the present status of elephant conservation and the problems that are encountered in conserving elephants in the existing protected area network. Section four of the IS contained the most important questions in the survey, where respondents were presented with dichotomous choice elicitation to assess their WTP for the conservation of elephant.

Section five of the IS contained a set of questions for the interviewer. In these questions, interviewers were asked about the level of understanding and sincerity of the respondents. Nine graduate students from the Faculty of Graduate Studies of the University of Colombo were used as interviewers to administer the IS. A face-to-face survey was conducted to gather the information. Hadker (1997) suggests that this is a more useful method compared to mailed questionnaires and telephonic surveys in developing country contexts.

A non-linear logit regression model was constructed to analyse the respondents' responses to the WTP elicitation questions. Jaibi and Raa (1998) provide a list of economic applications of this model and Pate and Loomis (1997) describe this model as the most commonly used non-linear model in CV studies. Sellar *et al.* (1986) outline the merits of the logit model, and Kanninen and Khawaja (1995) discuss the advantages of use of logit analysis for a contingent valuation survey with dichotomous format. One such advantage is the opportunity to use logit analysis, a non-linear method, to regress a binary (dichotomous) dependent variable on one or more independent variables. McFadden (1974) has also outlined the bases of the dichotomous choice theory corresponding to the logit specification.

In this study, we used the probability of the respondents' responses to principal WTP elicitation questions  $\{P_i / (1 - P_i)\}$ , where  $P_i$  = Probability of yes to the WTP elicitation questions as a dependent variable and considered factors that influence their probable responses. A number of socio-economic, demographic and attitudinal variables were included as independent variables for the preliminary logit analysis. The variables were: the respondent's age (*AGERE*), attitudes to alternative elephant conservation approaches (*ATHEC*), bid value (*BIDVA*), awareness of the current conservation issues (*CONSE*), concern about future generation needs (*FUPRE*), pro-conservation perception (*GREEN*), association with environmental guilds or groups (*MEMBE*), concern about non consumptive use-value of

the elephant (*NONUV*), personal income (*PERIN*), pro-development concern (*PRODE*), occupation (*OCCUP*), position in the household (*RPOSF*), total family income (*TOFIN*), and years of schooling (*YRSCH*). The choice of these variables was partly based on choices in several previous CVM studies of environmental valuation (see Whitehead, 1992; Miller and Lindsay, 1993; Bateman and Langgord, 1997; Witzer and Urfei, 2001).

#### **4. RESULTS OF THE LOGIT ANALYSIS**

The preliminary logit regression analysis was undertaken by using the Statistical Package for Social Sciences (SPSS) Version 10.0 to identify the factors associated with respondents' responses for the WTP elicitation question at the  $p < 0.05$  significance level. This analysis reveals that some of the independent variables cited above were either statistically not significant, or were highly correlated with other variables at the  $r > 0.8$  level. Hence, it was decided to exclude these variables from the final logit regression analysis. Several goodness of fit measures were used to estimate overall statistical performance of the estimated model in this study. These results indicate that the overall ability of the model to yield a correct prediction of urban residents' WTP for the conservation of elephant is significant at the 0.05 level of statistical significance. A summary of the final logit regression results is presented in Table 2.

As indicated in Table 2, most of the estimated coefficients have a positive influence on the probability of saying 'yes' to the principal conservation value questions by the respondents in the sample. The positive sign for the *CONSE* variable supports the hypothesis that the probability of the respondent saying 'yes' to the WTP question increases with the respondent's awareness of the present status of HEC and the issues involved in the conservation of elephants in Sri Lanka. Loomis and Ekstrand (1998) observe a similar situation in relation to conservation of the Mexican spotted owl. As might be expected, the coefficient for the

*NONUV* is positive and significant in the model. This suggests that a respondent who values the non-use values of elephant (such as altruistic bequest and existence values) has a higher probability of answering ‘yes’ to the WTP question. This is understandable because the elephant in Sri Lanka is closely associate with Sri Lankan, their history, religion, culture, folklore, mythology and ceremony.

**Table 2:** The factors influencing respondents’ responses for the payment principle questions: the final logit regression results

Variable	Coefficient	Standardized error	<i>t</i> -statistics	<i>P</i> -value
CONSTANT	-5.021	1.944	-2.098	< 0.013
AGERE	-0.872	0.377	-3.392	< 0.021
BIDVA	-1.029	0.258	-4.198	< 0.002
CONSE	1.045	0.075	4.685	< 0.001
GREEN	3.322	0.095	7.583	< 0.000
NONUV	1.284	0.541	2.904	< 0.003
PERIN	4.785	1.346	9.213	< 0.000
PRODE	-0.043	0.916	0.904	< 0.717
RPOSF	1.224	0.867	1.253	< 0.002
YRSCH	2.990	0.985	5.207	< 0.001

**Summary statistics:**

Dependent variable = the probability of saying ‘yes’ to the principle WTP questions, Number of observations =300; log- likelihood is 73.8654, F statistic: 31.1846;  $\alpha = 0.05$ ;  $df = 9$ ;  $R^2 = 0.0.6050$ ; Adjusted  $R^2$  0.5861.

**5. FACTORS INFLUENCING THE RESPONDENTS’ RESPONSE TO CONSERVATION VALUE QUESTIONS**

The coefficients for the attitudinal variables such as *GREEN*, are positive and significant. The result suggests that respondents with pro-conservation attitudes are likely to contribute more towards the conservation of the elephant. Loomis and Larson (1994) observe a similar situation in a CV survey of the grey whale. On the other hand, the variable *PRODE* was used in the model to assess the response of anti-conservation attitudes on the probability of saying ‘yes’ to the WTP question. The *PRODE* was not significant. This is understandable because the majority of the respondents in the sample disagreed with development programs that cause environmental problems. In our preliminary discussion when we put the proposition “*Sri Lanka should not encourage development programs such as tobacco cultivation in central highlands that cause serious environmental damage*”, 88.6% respondents agreed, implying that they were rather ‘green’, and inclined strongly towards environmental protection. Hadker *et al.* (1997) observe similar attitudes in a CV study in India. In this study, it was found that about 72% of respondents strongly disagreed with development programs that hurt the environment.

*BIDVA* had a negative influence on the probability of the respondent saying ‘yes’ to the WTP question. This means that the larger the bid value presented in the interview to the respondent as a WTP elicitation question, the less willing these respondents were to pay for elephant conservation. Miller and Lindsay (1993) notice a similar relationship in a CV survey which was conducted to analysis WTP for a state gypsy moth control program in New Hampshire. Loomis and White (1996) also observe a similar result in an analysis of economic benefits of rare and endangered species.

Among the socio-economic characteristics, age, personal income, years of schooling, and respondent’s position in the family were considered as influences on the probability of respondents being willing to pay for the conservation of the elephant. The positive sign of the

coefficient of the *YRSCH* indicates that the probability of saying ‘yes’ for the WTP question increases with an increase in the number of years of schooling. This is understandable because more years of schooling would arguably increase the knowledge a person has about social, political, economic and environmental happenings. Moreover, the education would help a person comprehend news about environmental effects of economic development. Several CV studies find a similar relationship between level of education and respondent’s response towards the WTP elicitation questions. For example, Whitehead (1992) noticed that the level of education is often positively correlated with the WTP amount in an *ex ante* willingness to pay analysis. Pate and Loomis (1997) describe the rationale behind this relationship in a case study of wetland and salmon conservation in California.

The variable *AGERE* is significant with a negative coefficient. This implies that younger respondents were more willing to say ‘yes’ to the WTP question than their older counterparts in the sample. Heinen (1993) observes a similar situation in a study of people’s attitudes towards the wildlife in the *Kosi Tappu* Wildlife Reserve in Nepal. In this study, he found that the positive attitudes towards the preservation of nature could be measured by the individual willingness to pay amounts which correlate highly with the respondents’ age, years of schooling and the gender. He also notices an interesting relationship between age and the years of schooling. Younger respondents are found often to have more years of schooling than the older ones in the sample. This is quite similar to the situation found in Sri Lanka.

The variable *PERIN* is significant. The positive sign of it implies that the respondents whose personal income is greater are more willing to pay for the conservation of the elephant than the respondents whose personal income is lower. A number of other CV studies have obtained a similar result. Boyle and Bishop (1987) estimate the effects of the income on the determination of WTP amount for the conservation of endangered species. Carson *et al.* (1996) found that the

sum individuals are less willing to pay for the preservation of quasi-public goods tends to rise with their income. Loomis and Larson (1994) estimate an individual's WTP for increase in the quantity of an environmental public good in relation to a number of socio-economic factors including household income. Findings of Hadker *et al.* (1997) suggest that the higher income earners in the metropolitan area of Bombay have a stronger interest in environmental conservation than the lower income earners.

The variable *RPOSF* is significant with a positive contribution to the likelihood of being WTP for conservation of elephants. However, this result may be linked to the traditional Sri Lankan family culture and values. In this setting, families are represented by the head of the household. In most cases, the head of the household is the father (or the mother in the absence of the father) or the oldest child (in the absence of both the father and mother). As a result, in this study over representation of heads of households in the age group of 30 years and above was unavoidable. This cultural situation restricted the opportunities to interview the other members in certain households. In most cases, such opportunities were found only where the head of the household was absent at the time of the interview and he or she permitted another family member (in most cases the most educated person in the family) to represent him or her in the interview.

## **6. THE AGGREGATION AND EXTRAPOLATION OF WTP BENEFITS**

The simple transferring point estimate approach (STPE) was used to extrapolate WTP benefits. A number of recent contingent valuation studies — for example, Loomis and Ekstrand (1998), Hadker *et al.* (1997), and Loomis *et al.* (2000) — have used this approach to extrapolate environmental benefits. Boyle and Bergstrom (1992) examine the advantages of this method compared to benefits function transfer approach (BFTA). Brouwer and Spaninks (1999) tested the statistical validity of the STPE approach and found it to be more robust than the other

approaches. Furthermore, Feather and Hellerstein (1997) found that the accuracy of the results obtained from BFTA depends heavily on the degree of similarity between the 'study area' and the unstudied 'policy area' (i.e. population of interest). Moreover, the use of the BFTA tends to create large biases when a major difference exists in the value of the non-market commodity to the different social segments in the same society. The debate about this approach continues and remains unresolved (Brouwer and Spaninks, 1999).

Nevertheless, mindful of the sensitivity of sample effects, we noted the results for the socio-economic attributes of the urban population in Sri Lanka from the census conducted by the Department of Census and Statistics of Sri Lanka (2002). It was found that the overall household characteristics of the urban dwellers in Sri Lanka were very close to those of the sample used in the present study. Therefore, extrapolation of final aggregate WTP urban estimates found in this study is likely to introduce little error. In the present study, the extrapolation of WTP benefits for the urban sample was carried out at three different levels: a) from the sample to the Colombo metropolitan area, b) from the Colombo metropolitan area to the major urban areas, and c) from major urban areas to the entire urban population in Sri Lanka. Although the mean WTP value of non-protest respondents is used to extrapolate from the sample to the population, we deduct 11.3% from the population to allow for protest bid. This means that the WTP of those with protest bids is treated as zero.

In our extrapolation process, we found that urban residents in Colombo metropolitan area were WTP Rs. 166.35 million per month for the conservation of elephant. This amounts to an annual value of Rs 1996.22 million. As the payment will be made over a period of five years, the total net present discounted value of these annual amounts, at a 5% real rate of discount, equals Rs. 9,075.02 million. Extrapolating to these results to all major urban areas in Sri Lanka, it was estimated that residents in these areas were WTP Rs. 438.48 million per month for the



conservation of elephant. This amounts to an annual value of Rs 5,261.17 million. As the payment will be made over a period of five years, the total present discounted value of these annual amounts, at a 5% real rate of discount, equals Rs. 24,554.20 million. Finally, when we extrapolate WTP for the entire urban population in Sri Lanka, using a population size of about 6.67 million (this figure was drawn by deducting 11.3% from the total population of 7.49 million people in urban areas to represent the protest responses based on the findings of the case study presented in this paper), we found it was Rs. 734.83 million per month. This amounts to an annual value of Rs 8818.01 million. As the payments are specified over a period of only five years, the total present discounted value of these annual amounts, at a 5% real rate of discount, equals Rs. 40248.61 million.

We know that urban residents are WTP Rs 8818.01 million per year for five years but we do not know their WTP beyond that. Damages caused by elephants will, however, continue in perpetuity given current populations of elephants. One possible way to compensate farmers would, in principle, be to invest the urban dwellers' contribution over five years in the capital market to give an estimated return on the capitalised sum of Rs. 2012.43 million per annum at a 5% real rate of interest. This could arguably be considered an indirect indication of the willingness of urban dwellers to pay in principle in perpetuity to conserve wild elephants.

It is also worth mentioning that although in this study, we asked respondents about their WTP for the conservation of elephants for only five years, some (maybe most) respondents certainly would probably be willing to pay beyond this period. Furthermore, this amount could be increased by at least another 100%, if we extended our extrapolation to the population of residents in the rural areas where elephants do not occur or interfere with farming practices.

## **7. URBAN RESIDENTS WTP FOR CONSERVATION OF ELEPHANTS EXCEEDS VALUE OF CROP AND PROPERTY LOSSES OF FARMERS**

As mentioned elsewhere in this paper, one of the objectives of this study is to find out whether the urban residents' WTP for conservation of elephants is sufficient to compensate farmers for the crop and property damage caused by elephants, and to raise farmers' tolerance of the presence of elephants. In this analysis, it was assumed that if urban dwellers could compensate farmers for losses associated with crop and property damages caused by elephants, given the current elephant population, and were better off than in the absence of wild elephants, the current population of elephants would be (Kaldor-Hicks) superior to the absence of wild elephants.

According to Bandara and Tisdell (2000b) the total value of the crop and property damage caused by elephants in Sri Lanka is about Rs. 560.71 million per cropping season or Rs. 1121.42 million per annum. These authors have derived this figure by extrapolating the elephant damages estimated in three selected case studies (see Bandara and Tisdell, 2002c; Jayawardene, 1998; and De Silva, 1998) carried out in three different locations in the elephant's range. However, before we use this figure to reach any conclusions, it must be noted that the crop and property damage calculated in this analysis did not pay much attention to the possible cost that could be associated with elephants other than crop and property damages. Under normal circumstances, the total economic cost should include the cost of control measures undertaken by farmers to scare away the crop-raiding elephants, income foregone by farmers in having to replace some crops with others that are less attractive to elephants, and the management cost borne by government departments to undertake various programs for the conservation of elephants and the mitigation of HEC. Such comprehensive assessments of total losses associated with the elephant are yet to be estimated.

Nevertheless, when we compare the economic estimates of crop and property damage caused by elephants of Bandara and Tisdell 2000b with above estimated return on the capitalised sum of Rs. 2012.43 million per annum, it shows that urban residents' financial support for the conservation of the elephant significantly exceeds the economic losses caused by the elephant. This means that our estimated return of Rs. 2012.43 million per annum on the capitalised sum in perpetuity is more than sufficient to compensate farmers for their estimated crop losses of Rs. 1,121.41 per annum; in fact almost twice the needed sum.

When compensation is paid, control of elephants by farmers is likely to be much reduced. Furthermore, a lot of their current control costs are ineffective in aggregate, either because elephants have become resistant to control measures or because, in many cases, control measures merely result in elephants moving from one farmed area to another (cf. Rollins and Briggs, 1996). Consequently, in the latter case, a type of prisoners' dilemma problem exists. If compensation for damage caused by elephants leads to much reduced control of elephants by farmers, they should achieve a net economic benefit because their control costs will be greatly reduced (or in the extreme case, eliminated) and the aggregate damage experienced by them from elephants will increase little or not at all. Nevertheless, there might be a small increase in damage in aggregate, if, for example, elephant populations increase slightly due to less harassment of elephants. Despite this, it is clear that, if compensation were paid to farmers, a sum of less than Rs 1,124.42 million per year would compensate them if allowance were made for the reduced control effort of farmers. The latter will reduce farmers' costs of control.

## 8. CONCLUDING REMARKS

This study was conducted to survey a sample of urban residents in the Colombo metropolitan area to determine their willingness to pay for the conservation of the Asian elephant in Sri Lanka. Application of logit analysis reveals that the years of schooling, income, age, bid value, pro-conservation attitudes, knowledge of the elephant related issues, and non use-value of the elephant were significant determinants of respondents' responses to the WTP elicitation question. It is estimated as a result of this analysis that urban residents' WTP for the conservation of the elephant in Sri Lanka is sufficient to compensate farmers for the damage caused by elephants. This indicates that the policy of compensating farmers for elephant damage so they will tolerate elephants on their farming fields might be viable. In conclusion, the overall findings of this analysis indicate that there is a strong economic case for ensuring the survival of wild elephants in Sri Lanka. Moreover, there is strong evidence that the current population of wild elephants in Sri Lanka is economically preferable to their absence considering the interests of all stakeholders, urban residents and farmers.

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